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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
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020995 MM91/0911  
KNOBBE MARTENS OLSON & BEAR LLP  
620 NEWPORT CENTER DRIVE  
SIXTEENTH FLOOR  
NEWPORT BEACH CA 92660

EXAMINER

ROCCHEGIANI, R

ART UNIT

PAPER NUMBER

2825

DATE MAILED: 09/11/01

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

# Office Action Summary

Application No.

09/452,844

Applicant(s)

RAAIJMAKERS ET AL.

Examiner

Renzo N. Rocchegiani

Art Unit

2825

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 02 July 2001.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☐ Claim(s) 1-66 is/are pending in the application.
- 4a) Of the above claim(s) 36-54 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☐ Claim(s) 1-35 and 55-66 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☒ The proposed drawing correction filed on 02 July 2001 is: a) ☒ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) g.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

## DETAILED ACTION

### *Claim Rejections - 35 USC § 103*

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-4, 8, 20-26, 30-32, 35, 55 and 63-66 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent N. 5,650,351 (Wu) in view of U.S. Patent N. 4,058,430 (Suntola et al.).

Wu discloses a process to form a capacitor having a bottom 3-D folding electrode over a substrate comprising a trench, the electrode defining a volume and being connected via a metal line (Fig. 11). Wherein the bottom electrode is covered by HSG hemispherical grains, with a high dielectric layer formed over the grains (Fig. 11), the dielectric layer comprising one or more films of nitrides and or oxides, including metal oxides (col. 7, lines 15-20) with a total thickness that falls between 20 and 300 Angstroms (col. 7, lines 19-21).

Wu does not disclose layering the dielectric layer by depositing a set a mono-layers using alternating chemistries.

Suntola et al. teaches the formation of a dielectric layer by reacting the surface first with a first reactive species to form a first layer, then reacting the newly formed layer with a second reactive species to form a second layer, and to continue this

process to form as many layers as desired with the desired chemistries so as to form a dielectric layer of a preferred thickness (Abstract).

It would have been obvious to one having ordinary skill in the specific art to combine the teachings of Suntola et al. with the invention disclosed by Wu since, Wu discloses a highly dielectric layer and Suntola et al. teach a process to form a dielectric layer that will have a high dielectric constant.

3. Claims 5-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent N. 5,650,351 (Wu) in view of U.S. Patent N. 4,058,430 (Suntola et al.) and in further view of U.S. Patent N. 4,747,367 (Posa).

As stated in paragraph 2, all the limitations of these claims have been met except for teaching the use of a carrier gas and the purging the chamber after the formation of each mono-layer.

Posa teaches the operation of a chamber during the formation of multiple thin layers, wherein a carrier gas is mixed with the reactant gases and wherein each reactant gas is completely purged before the introduction of the next reactant gas (cols. 4 & 5).

It would have been obvious to one having ordinary skill in the specific art to combine the teachings of Posa with the Wu and Suntola et al. since, Posa teaches that by using a carrier gas and purging the chamber of a reactant gas before introducing the next reactant gas will minimize what Posa refers to as "dead space" (col. 3, lines 10-15).

4. Claims 9, 11-14, 28, 29, and 56-59 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent N. 5,650,351 (Wu) in view of U.S. Patent N. 4,058,430 (Suntola et al.) and in further view of U.S. Patent N. 6,090,659 (Laibowitz et al.).

As stated in paragraph 2, all the limitations of the claims have been met except for specifying that the reactant gases used to form the mono-layers comprise two metal species such as Ti, Al, Nb, and oxygen so as to form a dielectric layer with a dielectric constant greater than 20.

Laibowitz et al. teaches a method to form a dielectric layer over a semiconductor substrate by depositing mono-layers using reactant gases used to form the mono-layers comprise two metal species such as Ti, Al, Nb, and oxygen so as to form a dielectric layer with a dielectric constant of approximately 50. (col. 2, lines 55-67).

It would have been obvious to one having ordinary skill in the specific art to combine Laibowitz et al. to Suntola et al. and Wu since, Wu teaches the use of tantalum oxide desiring to obtain a high dielectric constant material and Laibowitz et al. teaches other materials that may be used so as to have a very high dielectric constant material layer.

It would also be obvious to one having ordinary skill in the specific art to form a metal nitride and to oxidize the previously layered material since, Wu already discloses forming a nitride also by forming an oxide layer over a previously formed layer inherently involves the oxidation of the previously formed layer.

5. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent N. 5,650,351 (Wu) in view of U.S. Patent N. 4,058,430 (Suntola et al.) and of

U.S. Patent N. 6,090,659 (Laibowitz et al.) and in further view of U.S. Patent N. 6,200,897 (Wang et al.).

As stated in paragraph 4, all the limitations of the claim have been met except for teaching the deposition of a dielectric layer using a metal, silicon and an oxygen containing gas.

Wang et al. teach a CVD of a dielectric material using silicon, a metal and an oxygen containing gas (col. 2, lines 21-26).

It would have been obvious to one having ordinary skill in the specific art to combine the teachings of Wang et al. to the invention disclosed by Wu, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416.

6. Claims 15 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent N. 5,650,351 (Wu) in view of U.S. Patent N. 4,058,430 (Suntola et al.) and of U.S. Patent N. 6,090,659 (Laibowitz et al.) and in further view of Ritala et al. ("Zirconium dioxide thin films deposited by ALE using zirconium tetrachloride as precursor" Applied Surface Science, 1993, pp. 333-340).

As stated in paragraph 4, all the limitations of the claims have been met except for teaching the deposition of the dielectric layer using a metal halide with an oxygen containing gas wherein there occurs a ligand exchange reaction with the oxygen containing species.

Ritala et al. teach the mono atomic layer deposition of a metal oxide such as Zirconium Oxide wherein a metal halide such as Zirconium tetrachloride, is reacted is an oxygen containing gas.

It would have been obvious to one having ordinary skill in the specific art to combine Ritala et al. to the Wu since, such a deposition process results in a layer with a more uniform thickness (Ritala et al.). Also, it is inherent that there will be an exchange of ligands since the two gases react with each other

7. Claims 33, 34 and 61 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent N. 5,650,351 (Wu) in view of U.S. Patent N. 4,058,430 (Suntola et al.) and in further view of Ritala et al. ("Zirconium dioxide thin films deposited by ALE using zirconium tetrachloride as precursor" Applied Surface Science, 1993, pp. 333-340).

As stated in paragraph 2, all the limitations of the claims have been met except for teaching the deposition of the dielectric layer using a metal halide with an oxygen containing gas wherein there occurs a ligand exchange reaction with the oxygen containing species.

Ritala et al. teach the mono atomic layer deposition of a metal oxide such as Zirconium Oxide wherein a metal halide such as Zirconium tetrachloride, is reacted is an oxygen containing gas.

It would have been obvious to one having ordinary skill in the specific art to combine Ritala et al. to the Wu since, such a deposition process results in a layer with a more uniform thickness (Ritala et al.). Also, it is inherent that there will be an exchange of ligands since the two gases react with each other.

8. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent N. 5,650,351 (Wu) in view of U.S. Patent N. 4,058,430 (Suntola et al.) and of U.S. Patent N. 6,090,659 (Laibowitz et al.) and in further view of Kukli et al. ("Atomic Layer Epitaxy Growth of Tantalum Oxide Thin Films from Ta(OC<sub>2</sub>H<sub>5</sub>)<sub>5</sub> and H<sub>2</sub>O" The Electrochemical Society, 1995, pp. 1670-74).

As stated in paragraph 4, all the limitation of the claim have been met except for teaching the deposition of a material that is self-terminated by organic ligands.

Kukli et al. teach the deposition of mono atomic dielectric layer that is self terminated by organic ligands.

It would have been obvious to one having ordinary skill in the specific art to combine Kukli et al. to Wu since, this process will form a smooth surface with uniform thickness (Kukli et al.).

9. Claims 18, 19, 60 and 62 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent N. 5,650,351 (Wu) in view of U.S. Patent N. 4,058,430 (Suntola et al.) and in further view of Kukli et al. ("Atomic Layer Epitaxy Growth of Tantalum Oxide Thin Films from Ta(OC<sub>2</sub>H<sub>5</sub>)<sub>5</sub> and H<sub>2</sub>O" The Electrochemical Society, 1995, pp. 1670-74).

As stated in paragraph 2, all the limitation of the claim have been met except for teaching the deposition of a material that is self-terminated by organic ligands, the material comprising tantalum or aluminum, wherein the deposition temperature is less than 350 degree C, and wherein the metal precursor is a metal ethoxide compound.



Kukli et al. teach the deposition of mono atomic dielectric layer that is self terminated by organic ligands wherein the precursor is a metal ethoxide comprising tantalum or aluminum, such ethoxide being reacted with an oxygen containing vapor at a temperature of less than 350 degree C.

It would have been obvious to one having ordinary skill in the specific art to combine Kukli et al. to Wu since, this process will form a smooth surface with uniform thickness (Kukli et al.).

10. Claim 27 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent N. 5,650,351 (Wu) in view of U.S. Patent N. 4,058,430 (Suntola et al.) and in further view of Watanabe et al. ("A New Cylindrical Capacitor Using Hemispherical Grained Si (HSG-Si) for 256Mb DRAMs", IEDM 1992, pp. 259-262).

As stated in paragraph 2, all the limitations of the claim have been met except for teaching the formation of a cylindrical electrode.

Watanabe et al. teaches the formation of an electrode with HSG grains over it, wherein the electrode has a cylindrical shape.

It would have been obvious to one having ordinary skill in the specific art to form a cylindrical capacitor structure since, a capacitor with such a shape will be denser (Watanabe et al.).

### ***Response to Arguments***

11. Applicant's arguments filed on July 2, 2001 have been fully considered but they are not persuasive. The examiner appreciates applicant's compliance with drawings requests and has accepted the drawing as amended to be in proper form hence all

objections to drawings and specification have been withdrawn. The applicant argues first that there is no motivation to combine the patent to Wu with the patent to Suntola et al.. The applicant further argues that it would not be obvious to form a highly dielectric layer over the HSG. In regards to the motivation to combine applicant argues that the patent to Wu does not suggest using ALD to deposit the dielectric layer over the HSG. As stated in the rejections, the patent to Wu does not teach depositing the dielectric layer over the HSG by way of ALD, yet applicant's assertion that it should in order to be combined with Suntola et al. is not persuasive. Section 706.02(j) of the MPEP, which applicant has referred to, also states that "there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art." The Wu references discloses the deposition of a dielectric layer of a thickness that is preferably 50 angstroms, the Wu reference also discloses that the dielectric layer is a high dielectric film. Furthermore, Wu does not limit his invention to any specific type of deposition. A general worker in the art would be well aware of the teachings of Suntola et al., because, as applicant has also stated, the teachings of Suntola et al. have been known for over 20 years. Suntola et al. teach a process to deposit a dielectric layer so as to have a very good control over the thickness of the layer, hence being able to make it very thin as preferred by Wu, and also to make a dielectric with a high dielectric constant as it is also disclosed by Wu. Thus, the examiner opines that there is enough motivation to combine the two references. As for the applicant second point, that it would not be obvious to form a high dielectric layer over an HSG surface because additional prior art states that it is a problematic process,

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the examiner is not persuaded since nowhere the examiner stated that it was obvious to deposit a high dielectric material over the HSG surface, this limitation is clearly disclosed by the main reference. Examiner directs applicant's attention to column 7, lines 14-20, of US Patent N. 5,650,351 (Wu), wherein it states "Next, a capacitor dielectric layer 42 [the dielectric layer over the HSG surface] is deposited over the bottom storage electrode 28. The capacitor dielectric layer can be composed of a triple film of Oxide/Nitride/Oxide (ONO), a composite film of nitride/oxide, silicon nitride, silicon oxide or **a high dielectric film** such as tantalum oxide." Thus, applicant's argument that such limitation would not be obvious is moot on the grounds that the limitation is disclosed by the main reference. The examiner has not been persuaded by the applicant's arguments and has decided to maintain the rejections as previously presented.

### ***Conclusion***

12. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

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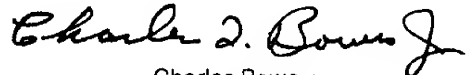
the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Renzo Rocchegiani whose telephone number is (703) 308-5839. The examiner can normally be reached on Monday through Friday from 8:30 am. to 4:30 pm..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Smith, can be reached at (703) 308-1323. The fax phone number for the organization where this application or proceeding is assigned is (703) 305-3432.

RNR

August 30, 2001



Charles Bowers  
Supervisory Patent Examiner  
Technology Center 2800